

Comparative analysis on Computing Disparity map

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Abstract—The stereoscopic images or stereo pair image consists of two images of the same scene taken slightly horizontally separated points from the left view and the right view. The disparity for stereoscopic image is horizontal distance between two matching pixel. The disparity map is horizontal pixel distance for each pixel coordinates. In this paper we computed disparity map using Minimum Index method, Matlab in build function method and Minimum sum Belief propagation method. The computing disparity map at different disparity levels is explored. The computational error estimation and runtime analysis is also performed at disparity level sixteen.

Index Terms—Stereo Image, Disparity, Disparity Map

I. INTRODUCTION

The stereoscopic images or stereo pair image consists of two images of the same scene taken slightly horizontally separated points from the left view and the right view. The objects near the camera will represent more to the right in left image and more left in the right image in stereoscopic or stereo pair images due to parallax effect. The horizontal displacement of an object left and right view depends on the distance from the object to the camera view points.

The disparity for stereoscopic image is horizontal distance between two matching pixel and horizontal pixel distance for each pixel coordinates is Disparity map. The Depth map or Disparity map is a gray scale image which is highly compressed. The Depth map or Disparity map shows distance rather than texture. If shift of pixel between right and left stereo image is more than object looks darker which is located far away from camera and if shift is less than object is bright i.e. object close to the camera.

There are various methods to find Disparity map or Depth map which is Area-based, Feature- based and Global based methods. The Area and Feature based methods are based on intensity profile. The constrains in Area- based algorithm is to find the optimal size of the window. The Feature-based algorithms are restricted to using only specific feature, that only yield sparse disparity maps. The Global methods are based on Bayesian approach to finds disparity as an energy minimization problem.

Some Applications of disparity map are:

- 1) Disparity map is used to reconstruct 3D model sequences which can be used either for information transfer or for entertainment

- 2) In Robotic application disparity map is used to navigate and object recognition where to separate occluded region in image components
- 3) Scientific application of Disparity Map are to extracts information from aerial surveys and for calculation of contour maps

In this paper we computed disparity map using three different methods which are Minimum Index Method ,MATLAB in build function 'Disparity Map' from computer vision tool box and third method Minimum Sum Belief propagation. The error estimation shows that disparity map using Minimum Index method at disparity level sixteen is better than other two methods. The subjective analysis with respect to ground truth images shows that disparity map at disparity level sixty four is using Minimum Sum Belief propagation is more compensable to other two methods.

This paper is organized as follows: Literature survey is given in section II, overview of method used is explained in section III, experimental results shown in section IV and its discussion elaborated in section V and conclusion is given in section VI

II. LITERATURE SURVEY

The method used in [1] "Adaptive support -weight approach for correspondence search" is area based local method to generate depth map or disparity map. The proposed method is based on Gestalt grouping in which support weight is based on similarity and proximity and is proportional to the strength of the grouping. In this method these two values expressed as a single value in an integrated manner. The group of similarity is calculated by means of Euclidean distance whereas group of proximity is by means of Laplacian Kernel. The weight adoptive method computationally takes more time than other methods.

The method used in [2] "A New Approach for Disparity Map Estimation from stereo Image Sequences using Hybrid Segmentation Algorithm" is feature based local method to generate depth map or disparity map. The estimation of Disparity map is by using K-mean square algorithm and hybrid segmentation algorithm. The K means clustering algorithm is used to group the objects based on some criteria. K is a positive integer. The criteria for grouping is by minimizing the distance between data and cluster centroid

.Initial set of K, virtual points in the data space randomly selected and every point if data set is assigned nearest centroid. The position of centroid is updated by means of the data points assigned to the cluster. The algorithm is stopped when minimum shift is below threshold. The segmentation algorithm extracts feature by Scale Invariant Feature Transform (SIFT) and Sum of Absolute Difference (SAD).The proposed algorithm is complex and computation time is more.

The method used in [3] "A Comparative Study of Energy Minimization Methods for Markov Random Fields" is global based method to generate depth map or disparity map. The method used is energy minimization problem on rectangular grid of pixels where energy expressed as data term and smoothness term. The method used is complex and computation time is more.

The method used [7] in "A Region Based Stereo Matching Algorithm Using Cooperative Optimization "is region based stereo matching algorithm using cooperative optimization. In cooperative optimization regions are selected using color statistics and constrains on smoothness and occlusion between adjacent regions. The first step in Cooperative Optimization is color based segmentation to partition in to regions according to homogeneous color for reference image. The second step is using window based method to find initial disparity estimate for each pixel and plane fitting technique is used to obtain parameters of disparity plane corresponding to each image region. Final step is that under the framework of inter-regional cooperative optimization, the disparity plane parameters of all regions are iteratively optimized by a local optimization procedure until a reasonable disparity map is obtained

In research paper "Efficient Loopy Belief Propagation using the Four Color Theorem"[12] shows that to reduce the computational complexity of belief propagation by applying the Four Color Theorem (FCT) to limit the 10 maximum number of labels in the underlying image segmentation to at most four. This provides substantial speed improvements for large inputs, and this for a variety of vision problems, while maintaining competitive result quality.

The Four-Color Theorem based on the max-product belief propagation technique can be used in early computer vision for solving MRF problems where an energy is to be minimized. Methods used in this research yield results that are comparable with other methods, but improve either the speed for large images and/or large label sets (the case of image segmentation, stereo matching and optical flow), or both the performance and speed (the case of image denoising).

The Four Color Theorem principle is difficult to apply in cases where the label set is discrete and no natural order/relation between them can be inferred. This is the case for stereo matching and optical flow, where the disparity cost function takes discrete, unrelated values. This causes slower convergence, but is compensated by the low time complexity of the methods, independent of the number of labels. Thus, the proposed methods perform faster than the standard methods considered here, at least for large inputs

In research paper "Comparison of graph cuts with BP for stereo using identical MRF parameters"[6]the disparity image can be achieved by modeling Markov Random Field and by using optimization algorithm such as Graph cut and Belief Propagation. These two algorithms allow fast and approximate solution to MRF which are powerful tools for modeling vision problems. So one system can improvement over the other is particularly to its choice of an inference algorithm.

III. OVER VIEW OF METHOD USED

The first method used to compute disparity map is using MATLAB in build function "Disparitymap" in computer vision tool box. The algorithm used in matlab in build function is Semi Global Block matching algorithm [4] .The sum of absolute difference is used to compare each block of pixel in stereo image and Semi Global Block matching

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Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, ac, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

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An excellent style manual for science writers is [7].

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ACKNOWLEDGMENT

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REFERENCES

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For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

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